



# Fiber Optic Sensing for Railroad Infrastructure and Assets

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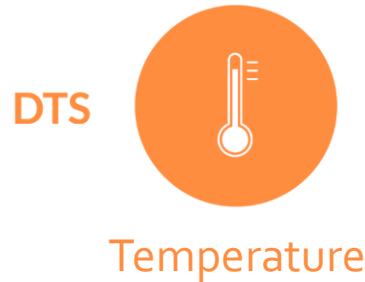
# What is FOSA?



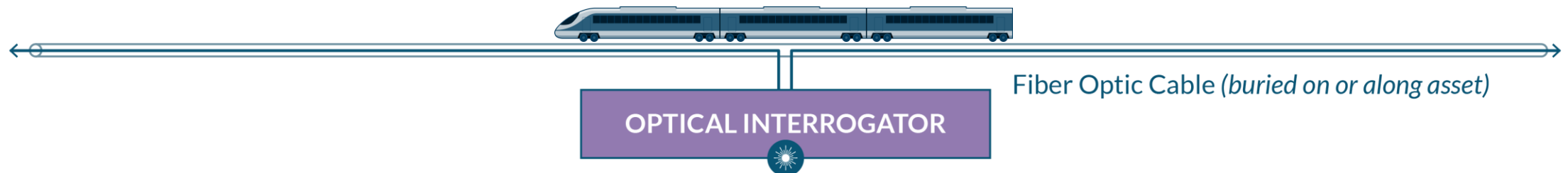
- The Fiber Optic Sensing Association is a non-profit industry association formed in 2017
- Provides education on the benefits of distributed fiber optic sensing technology:
  - Webinars
  - Videos
  - White papers
  - Developing standardized industry practices
  - Public policy advocacy
- Membership is open to companies globally who make, install, support and use distributed/quasi-distributed fiber optic sensors

# Introducing Fiber Optic Sensing

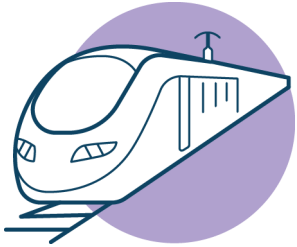
# What is Distributed Fiber Optic Sensing?



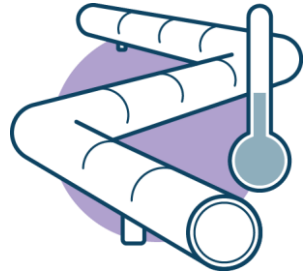
- Monitoring of fiber optic cables from a single location via pulsed laser light
- 24/7 Continuous Monitoring – over long continuous distances
- 1,000's of sensing points – high resolution with meter size localization potential
- Passive sensor: No power along asset
- Multiple applications possible in a single system
- Upgradeable technology - without replacing sensor



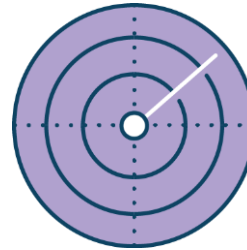
# Fiber Optic Sensing Applications



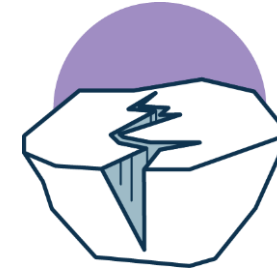
Transport  
Monitoring



Pipeline Heat  
Trace Monitoring



Third Party  
Intrusion/Security



Geo-Technics



Pipeline Condition  
Monitoring



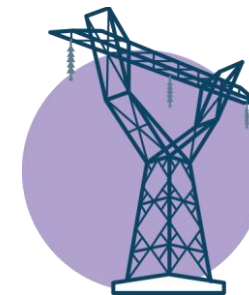
Oil & Gas In-Well  
Monitoring



Industrial Process  
Monitoring



Structural Health  
Monitoring

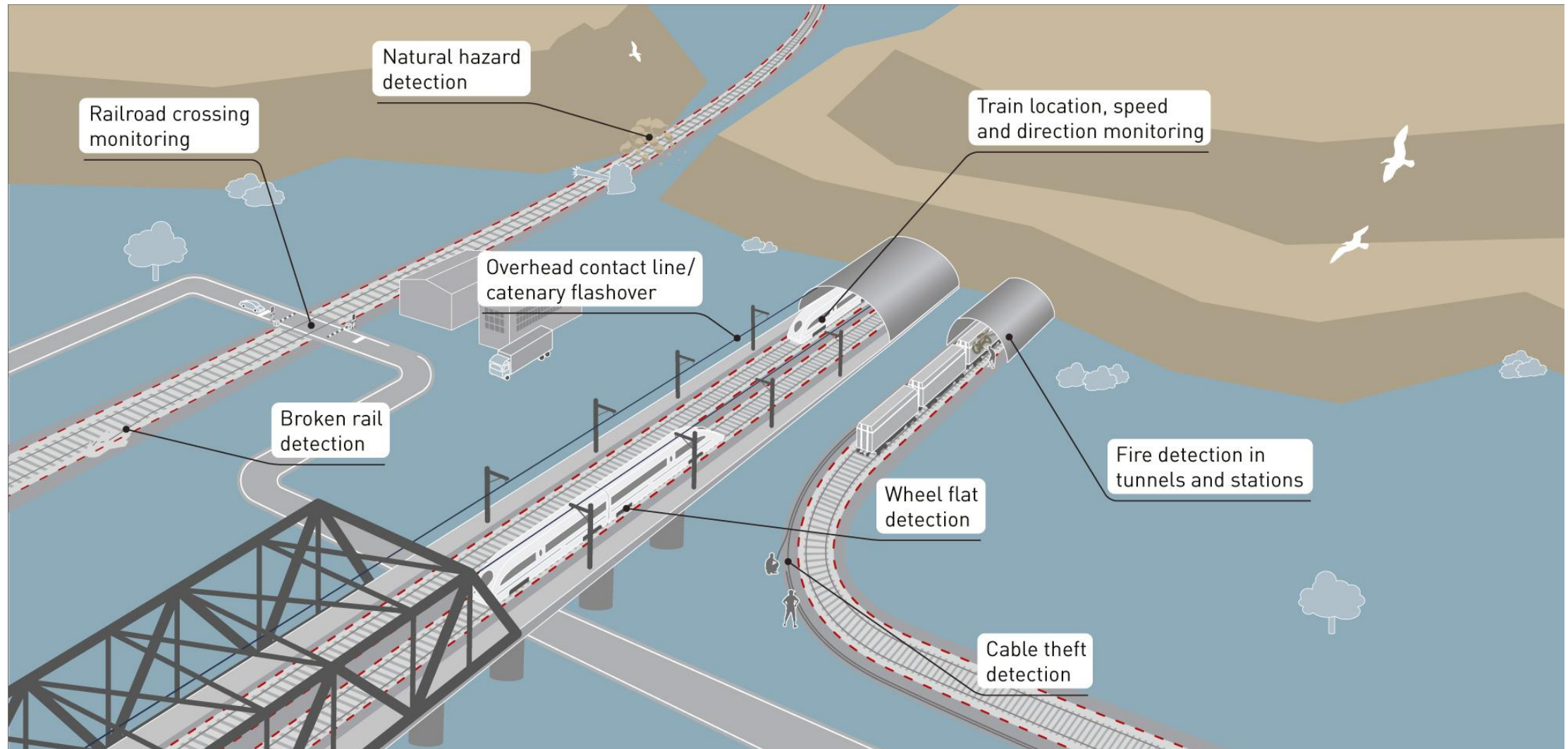


Power Cable  
Monitoring



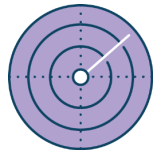
Fire  
Detection

# Applications in Railroads



# Key benefits / Railroad applications

- **Reliable**
- **Safe**
- **Retrofittable**
- **Economical**
- **Scalable**
- **Independent**



Security/threat detection



Train Tracking



Asset Condition Monitoring

**How is this data extracted from a fiber?**

# Short video to illustrate concept

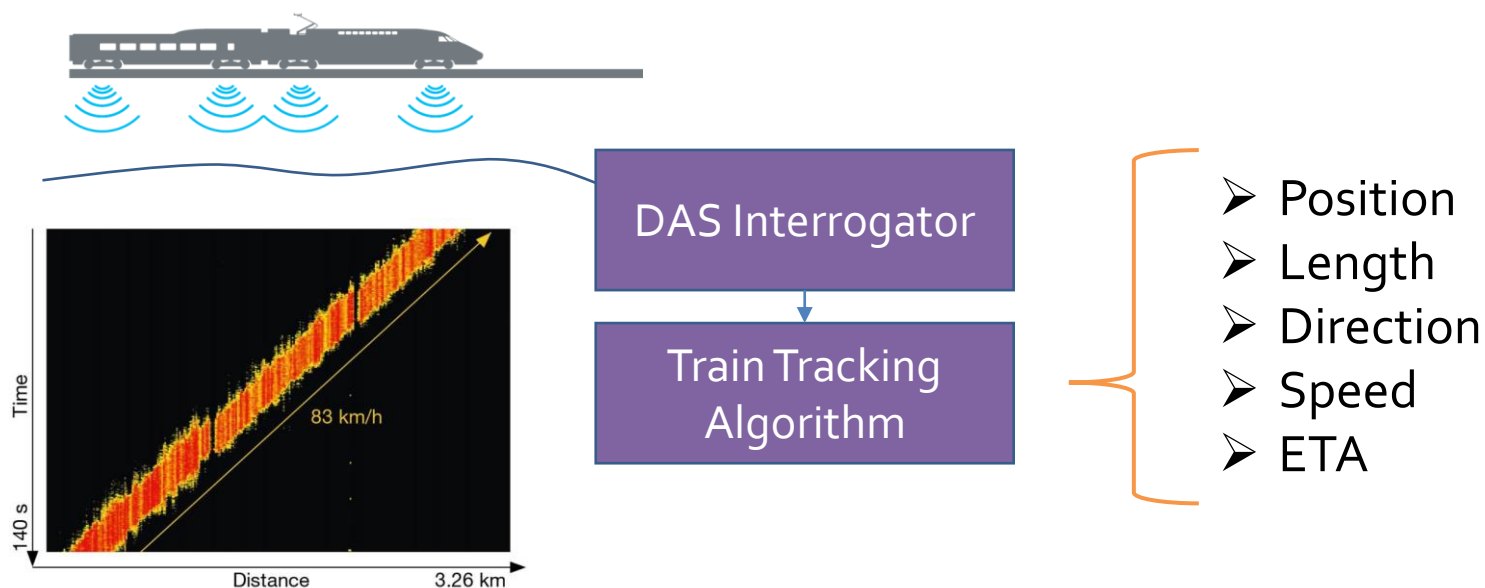


# How can DFOS help Railroad Operators?



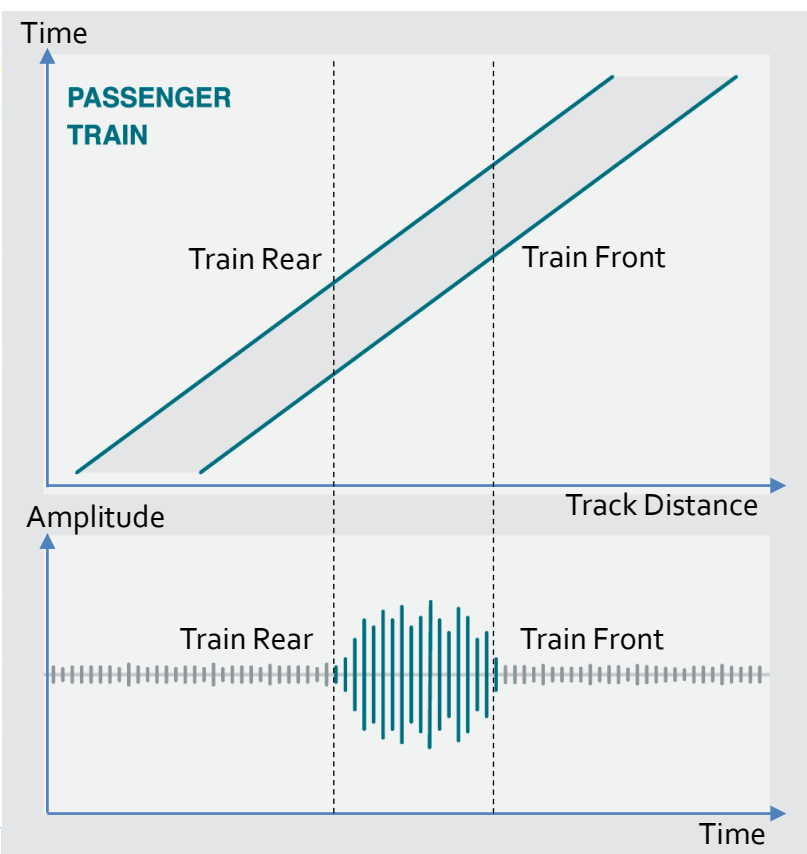
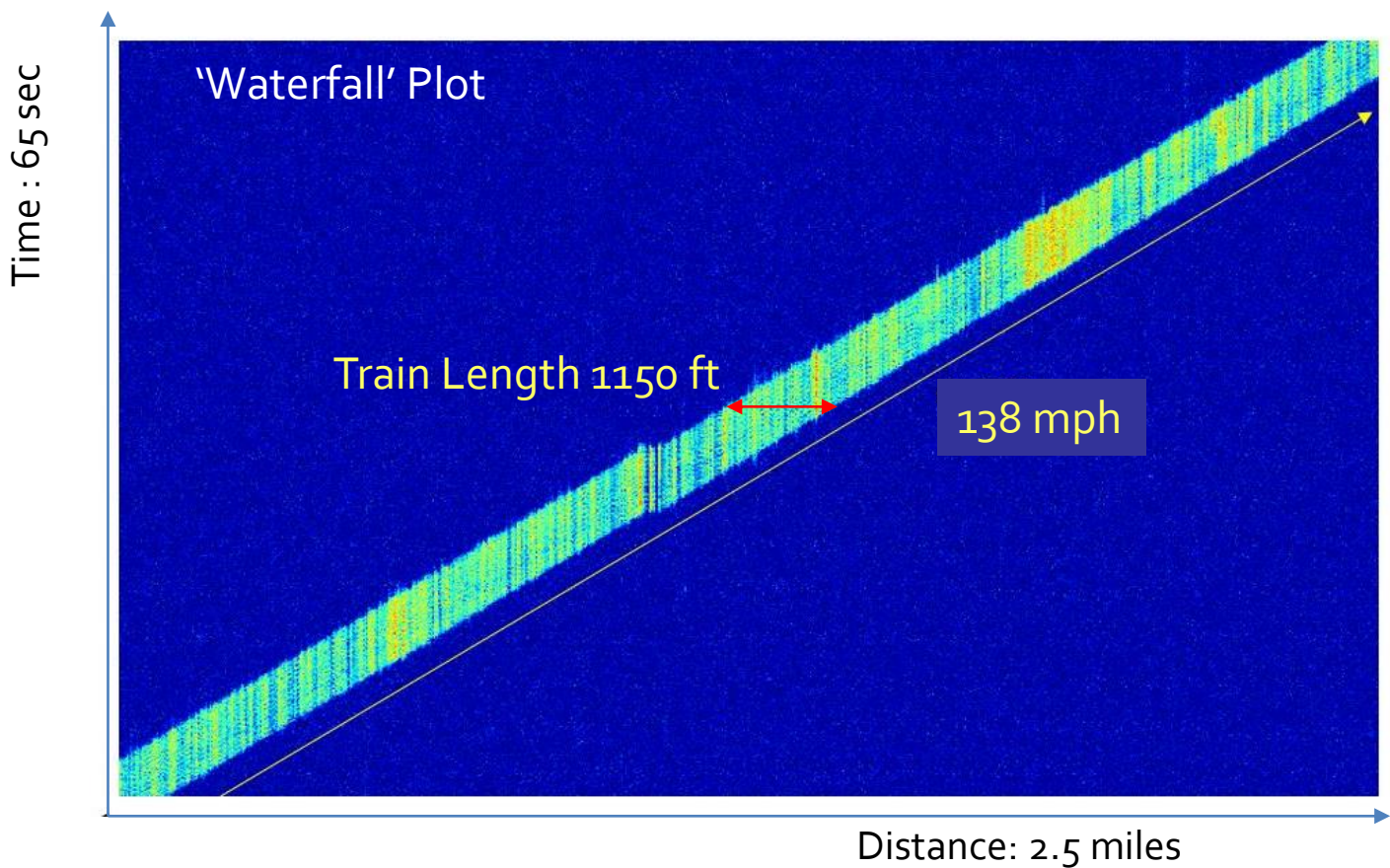
# Non-Vital Train Tracking

- DAS tracks trains even in 'dark' territories without train detection
- The acoustic energy from the moving train excites the fiber, allowing the train 'signature' to be detected and followed

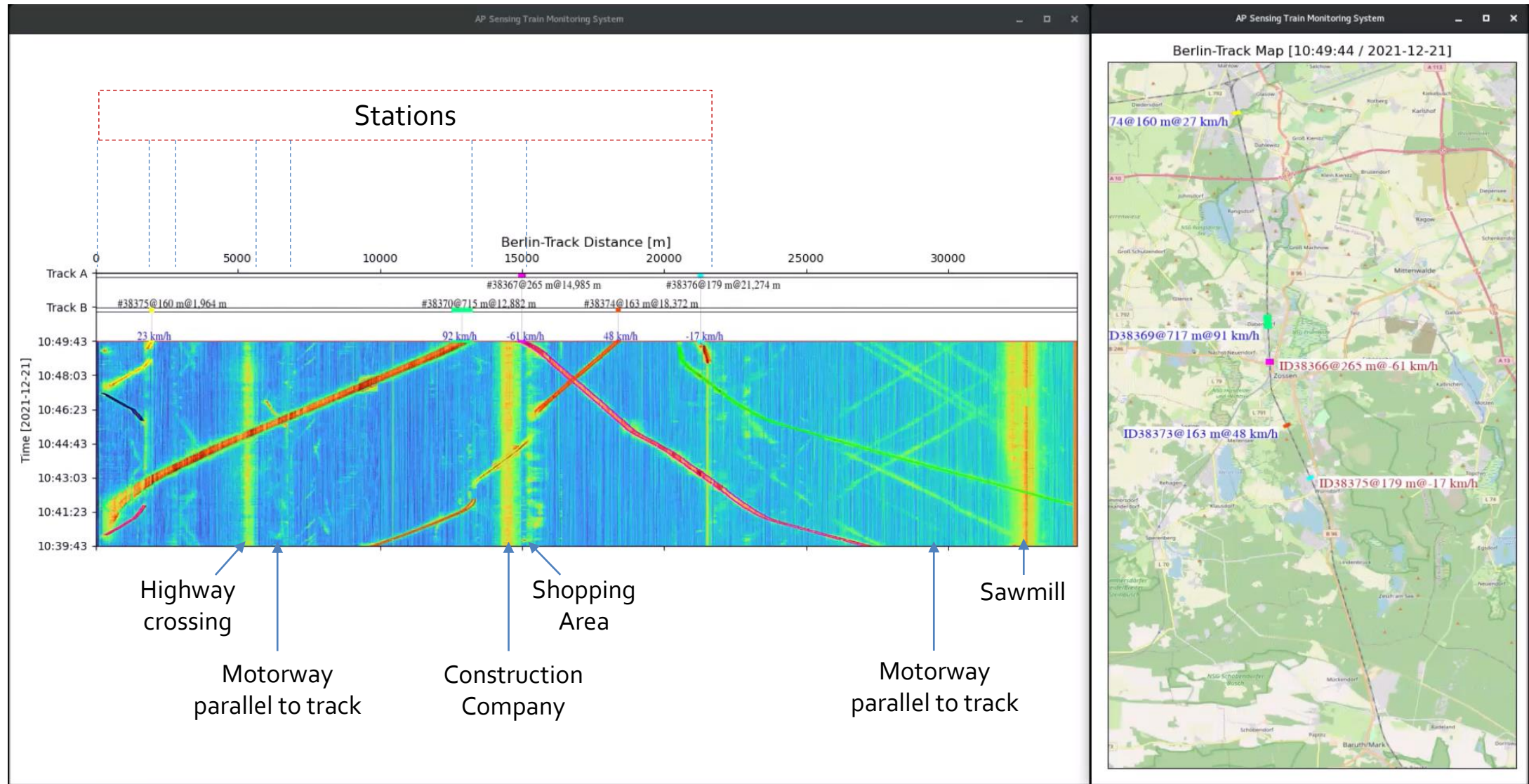




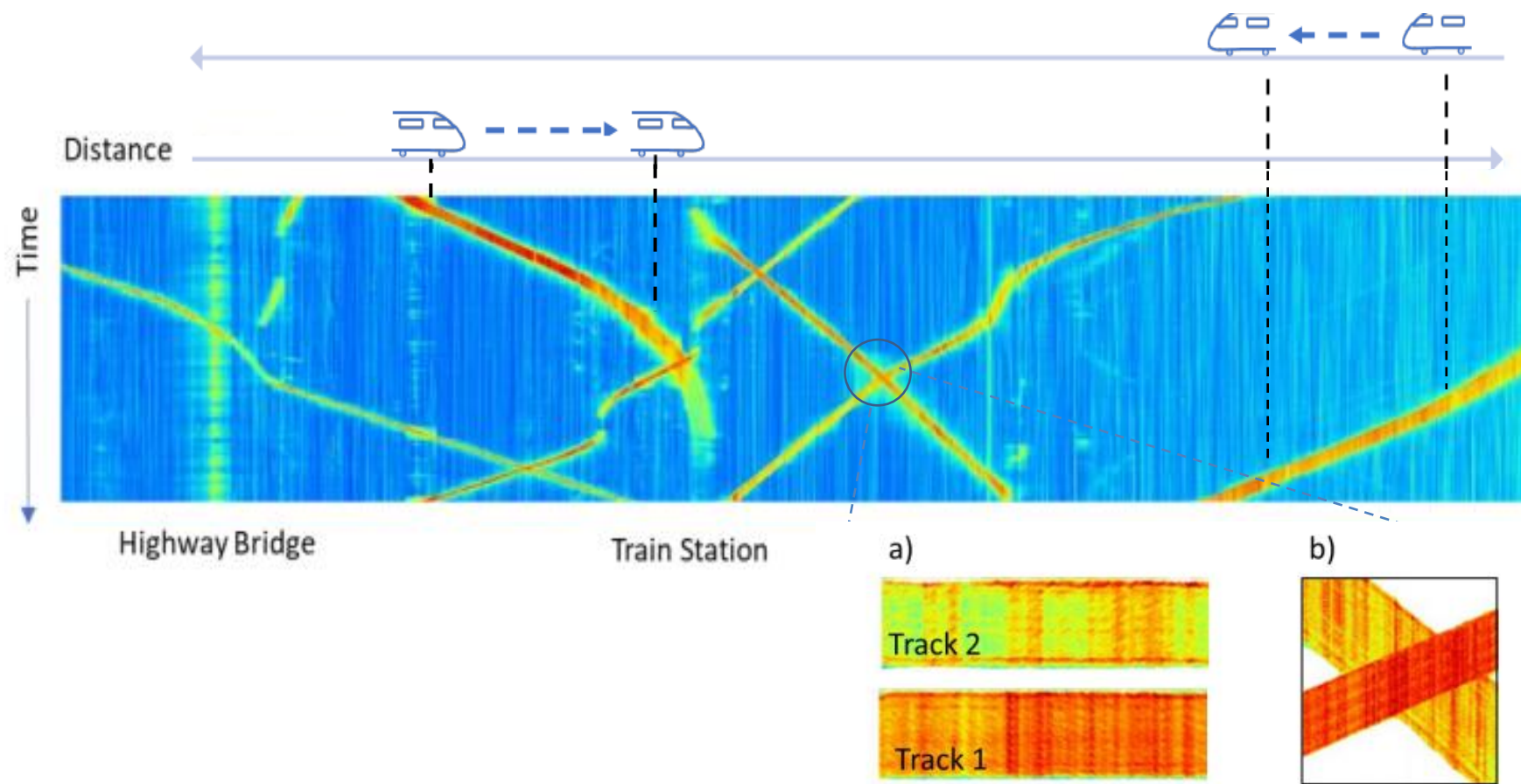
# Train Tracking – Example



# Train Tracking – waterfall & map view (at 8x speed)



# Track Selective Train Tracking

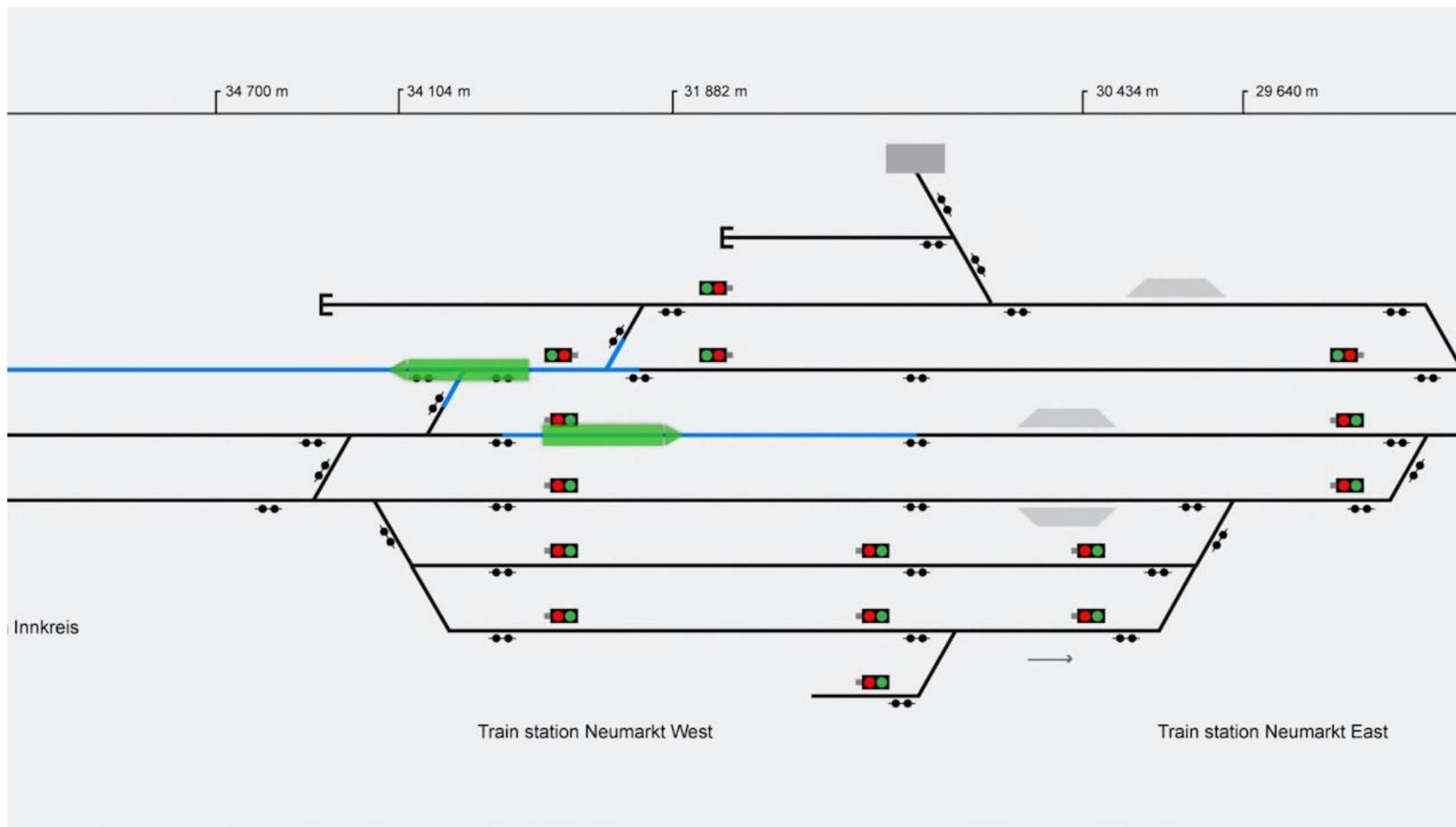


*a) Different Acoustic Fingerprints of Two Parallel Tracks*

*b) Track Selective Train Localization on Parallel Tracks.*



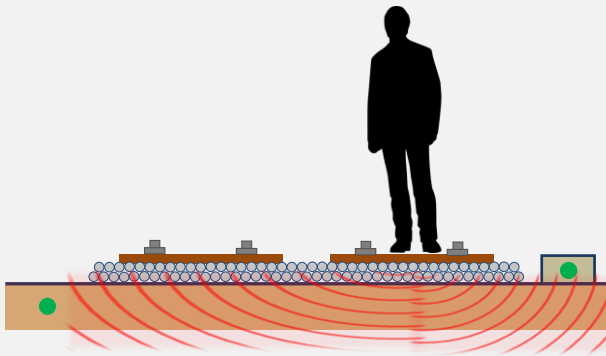
# Output Display



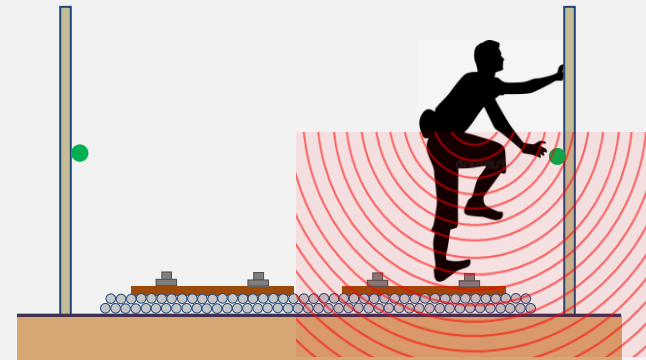


# Security & Threat Detection

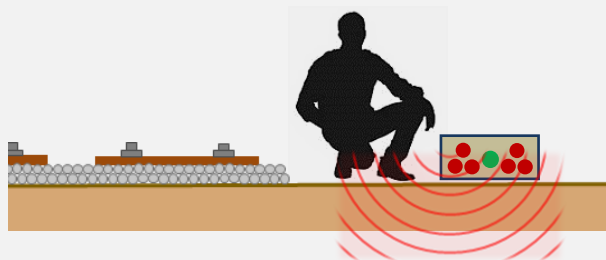
## 1. Personnel Detection



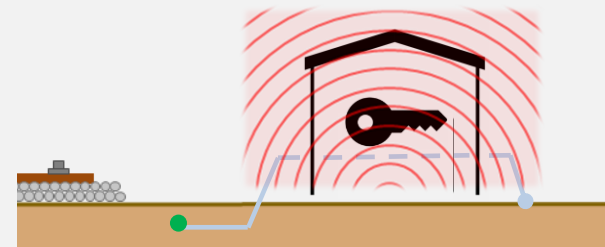
## 2. Sterile Zone Protection



## 3. Cable Theft



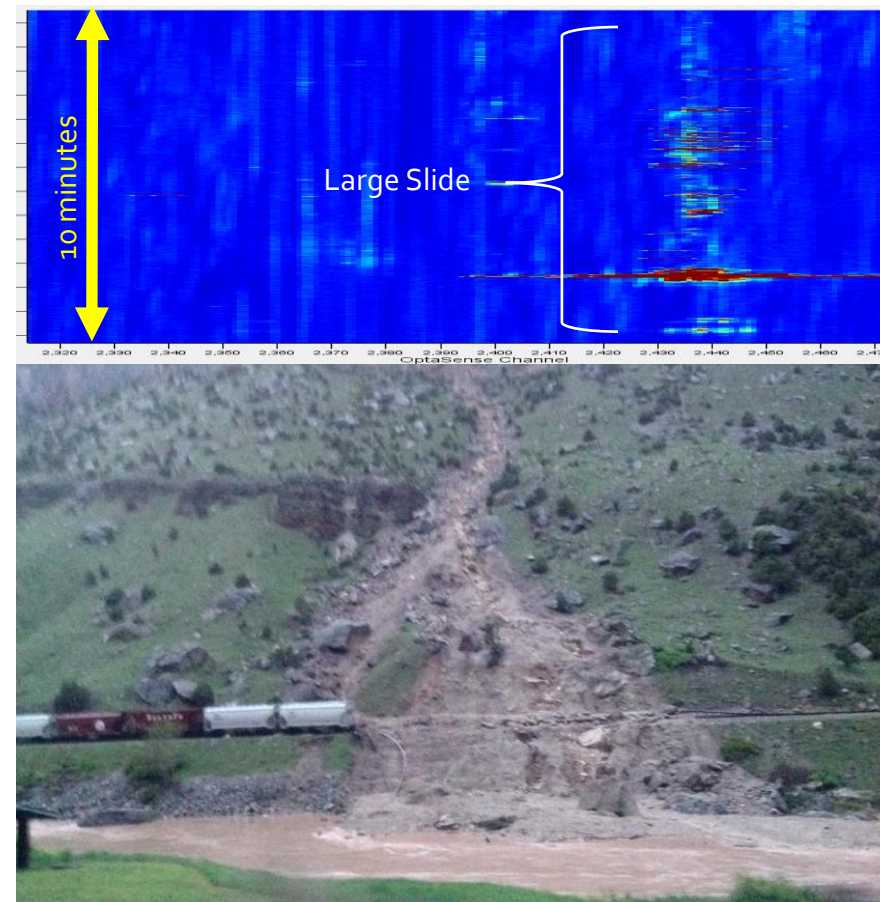
## 4. Critical Sites





# Rockfall and landslide – Case Study

- Rain within a canyon initiated a landslide
- Multiple landslide alarms raised by the DAS system to the dispatcher and announced over the voice radio

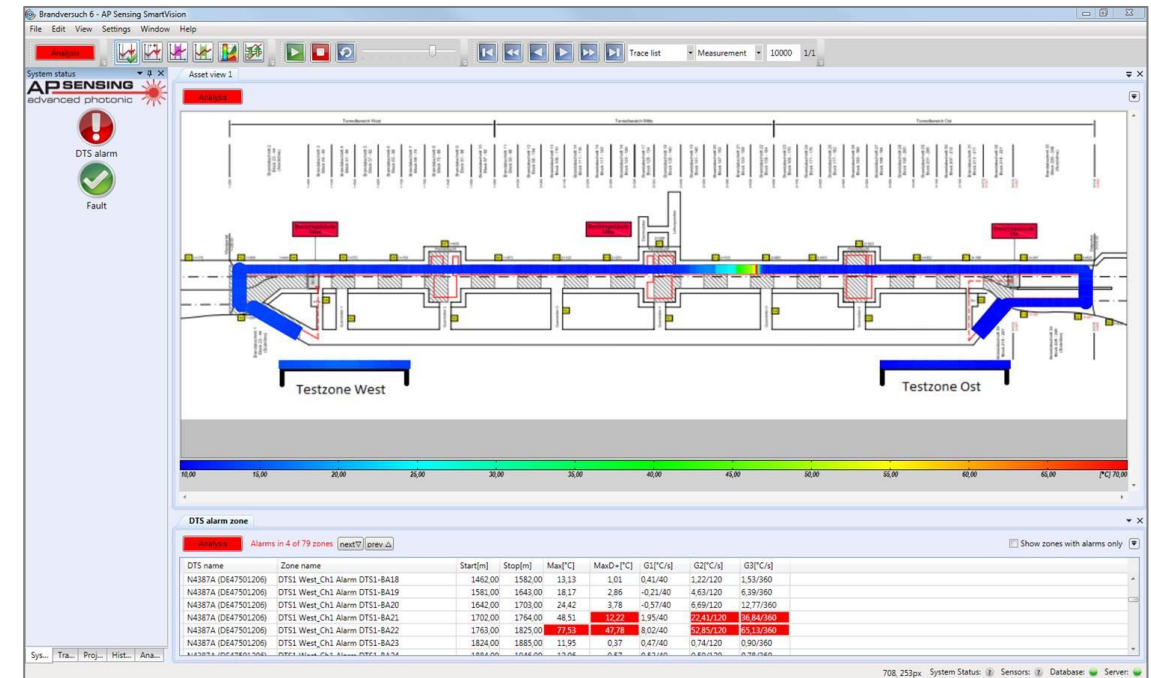




# Fire Detection in Tunnels / Stations



- Fire localization with 3m accuracy
- Fast alarming < 1 min by using time differentials and not just static limits
- Cost efficient & reliable
- UL, FM, VdS approved
- Thousands of installations



Example: Alarming within a zone

Fire Detection in the Euro Tunnel is just one out of thousands of train, metro, main station projects around the world.



# Asset Condition Monitoring

Asset condition can be monitored by FOS in support of condition based maintenance and as an aid to help prevent failures

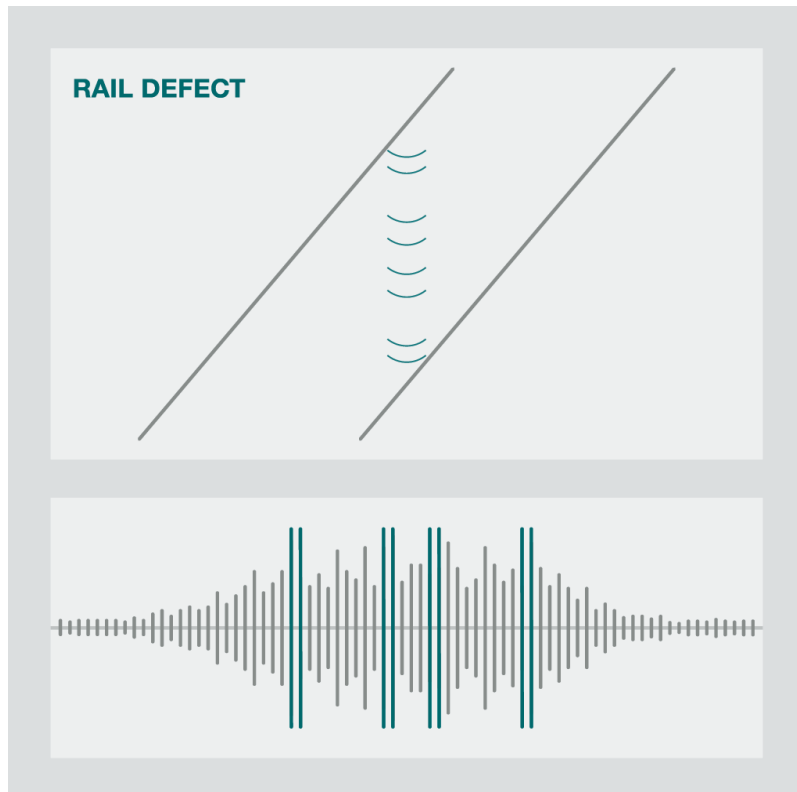
- Railroad Assets
  - Rail defects
  - Track bed defects / subsidence
  - Overhead Electrification
- Rolling Stock
  - Wheel Defects, e.g. flat wheel





# Track Defects - Example

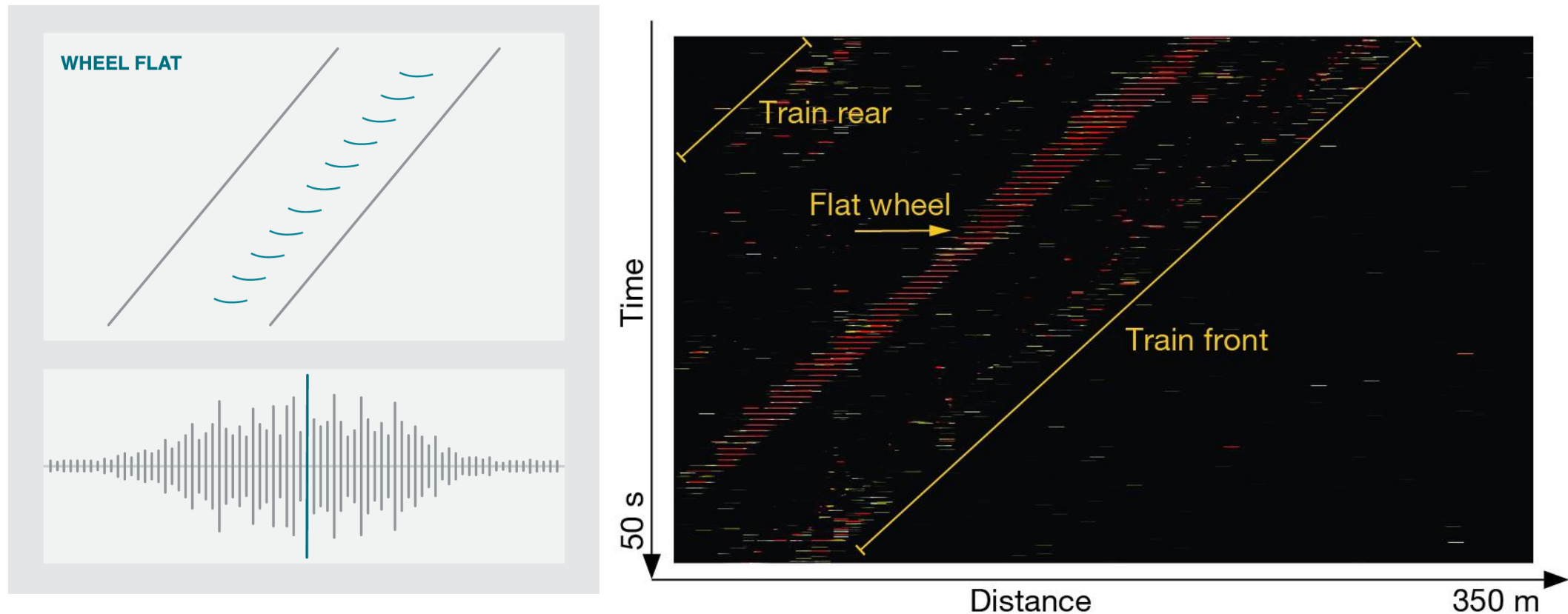
- Regular impulse at a fixed point within the train signature – periodicity depends on axle spacing and speed





# Wheel Defects - Example

- Regular impulse within the train signature, moving with the train  
Periodicity related to train speed and wheel diameter



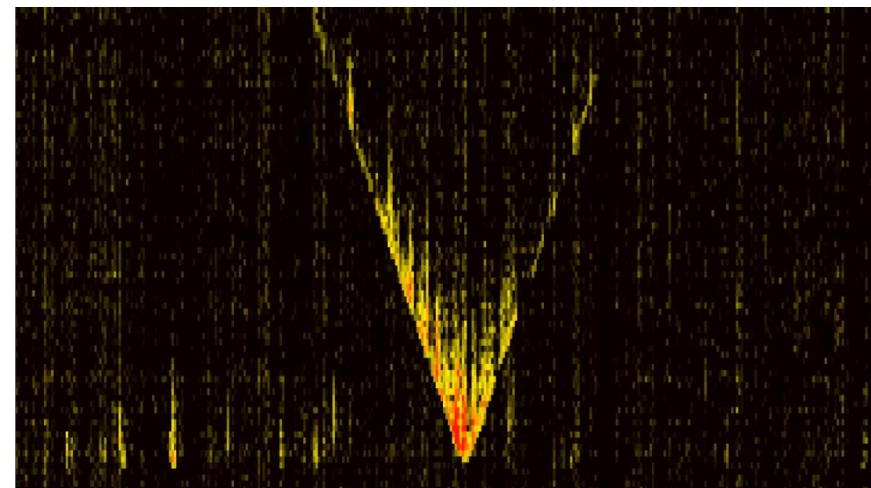


# Catenary Flashover

- Short Circuits in the overhead power line - power outage
- Inspection required to use track again

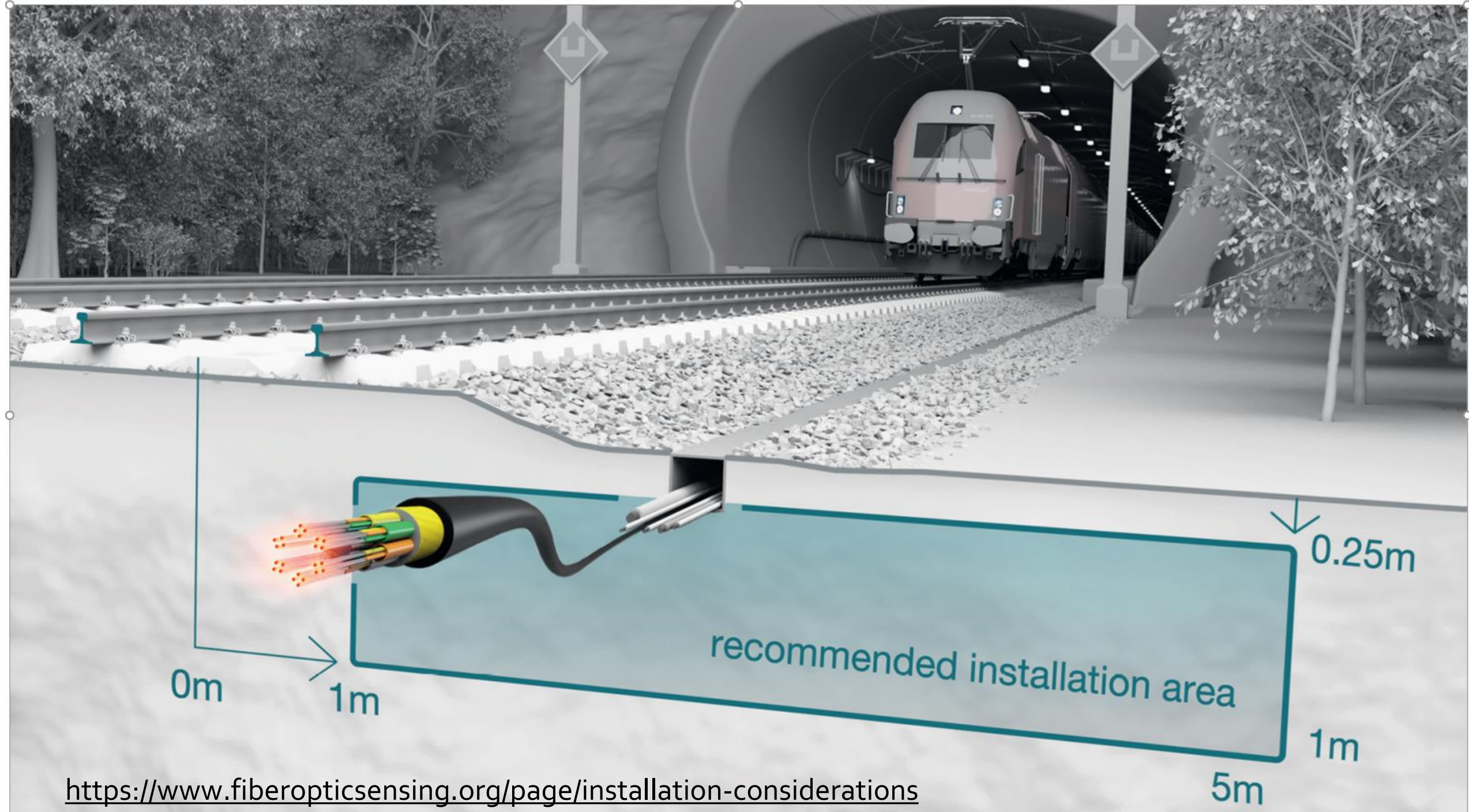
## How can DFOS help?

- Detect and locate flashovers much more accurately – down to a few meter
- Less inspection time = Better track availability = \$\$\$ Saving



# How simple is it to deploy Fiber Optic Sensing?





# Summary of the Railroad Applications & Benefits of Fiber Optic Sensing

# What are the Benefits?

- **Long reach** – spans greater than 80 km
- **Entire length** sensed in **real time**
- High **spatial resolution** – thousands of sensing points
- **Precise** event location detection
- **No** risk of **interference**
- No infrastructure trackside, or onboard.
- **Scalable** solution



Per sensing point, there is no more economical way to monitor lengthy, critical assets



# FOSA Members with Sensing Products



DAS



DTS



DSS





**Fiber Optic Sensing  
Association**  
Connect and Protect

# Thank You – Questions?

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Visit our website at [fiberopticsensing.org](https://fiberopticsensing.org)